The Presence of A Single Absorption Feature: What It Does and Doesn't Imply

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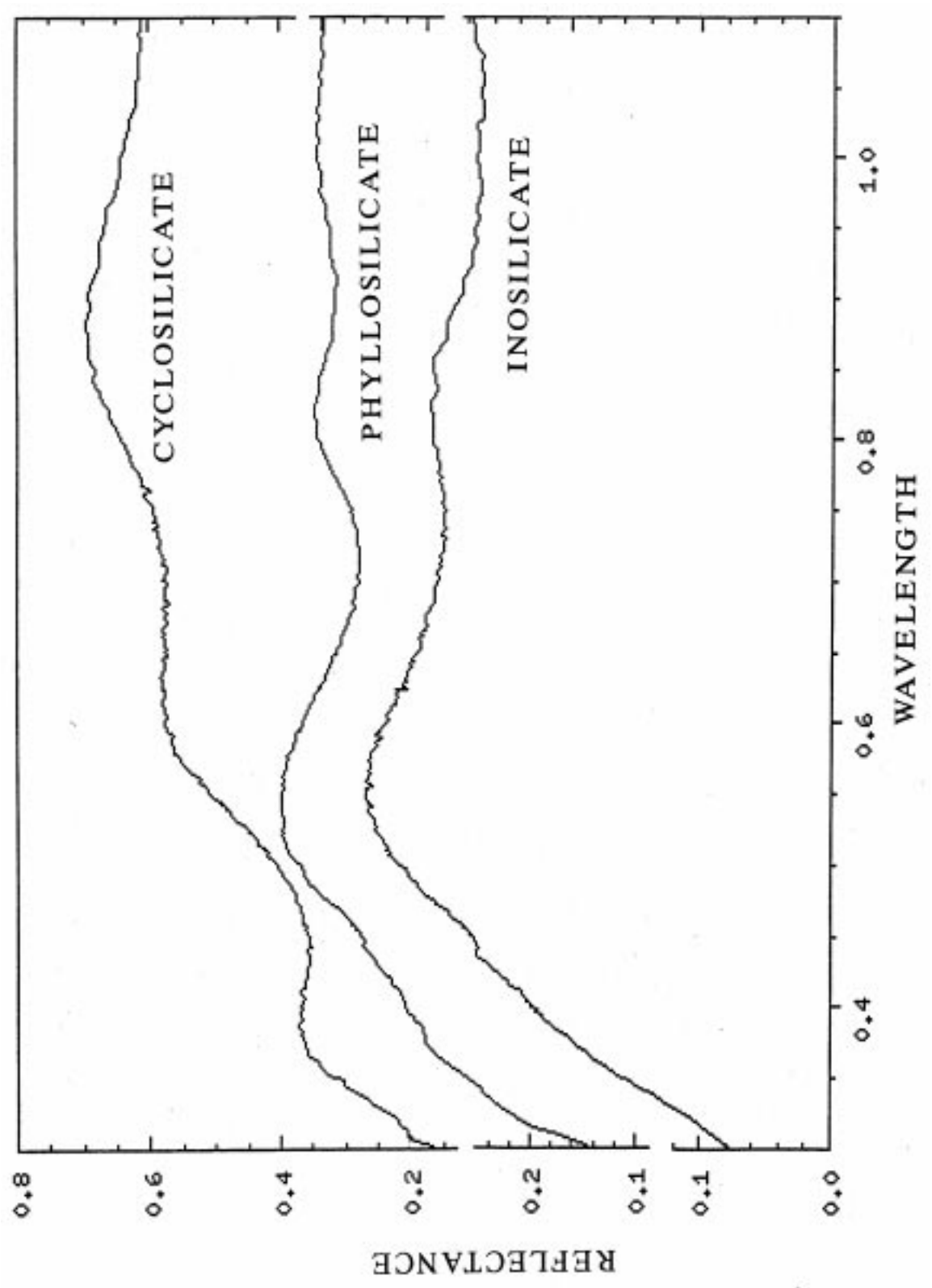
The interpretation of reflectance spectroscopy data of remotely sensed objects provides insight on surface chemistry and mineralogy. Remotely sensed data are interpreted on the basis of wavelength position, intensity and width of absorption features in the electro-magnetic spectrum. Primary physical and chemical parameters that affect the character of the absorption feature include major and trace element composition, crystal structure, abundance and grain size of the surface materials. The wavelength position of an absorption feature results from the composition and crystal structure of the material while the abundance and grain size distribution affects it's intensity. Absorption features can exist in disparate minerals at identical wavelengths because of similarities in chemistry and bond lengths. Thus, it is sometimes necessary to use absorption features at several wavelengths to correctly identify a specific mineral or mineral group. The identification of individual minerals and minerals groups allows assumptions to be made about surface and chemical processes on the remotely observed body.

Precautions should be taken in interpreing a single absorption feature, particularly if chemical and mineralogical conclusions have genetic implications. Similarly it is incorrect to assume that the presence of a single absorption feature at a given wavelength implies the existence of another absorption feature in some unobserved wavelength interval. This can be illustrated by examination of a 0.7 μm absorption feature which has been reported in laboratory spectra of Fe-bearing phyllosilicates (King and Clark, 1989) and in the spectrum of asteroids (Vilas and Gaffey, 1989; Vilas, 1994; and others). From examination of many laboratory spectra (Clark et al., 1993) we show that it is not reliable to assume that the presence of a single absorption feature at 0.7 μm results from the presence of a specific mineral.

A search of the USGS Spectral Library for minerals that had an absorption feature centered between 0.68-0.72 μm with a strength >0.2 percent and a width of more that 0.2 μm found 39 individual minerals that meet these criteria. Of these 39 minerals the greatest percentage are silicates, although oxides, hydroxides and sulfides are also present. The silicates are represented by phyllosilicates, inosilicates, and cyclosilicates (Figure 1), as well as nesosilicates. However, the vast majority are Fe- and (OH)-bearing minerals. Thus, the identification of a specific mineral, and assumptions as to structure, chemistry, and petrogenesis based solely on the presence of a 0.7 μm absorption feature are not justified. We suggest that future space missions which carry spectrometers and telescopic observing programs attempt to use a wavelength coverage that allows the observation of multiple diagnostic absorption features.

REFERENCES: Clark et. al., 1993, *USGS Open-File Report 93-592*; King and Clark, 1989, *Jour. Geophys. Res.*, 94, pp 13,997-14,008; Vilas, 1994, *Icarus*, 111, pp. 456-467; Vilas and Gaffey, 1989, *Science*, 246, pp. 790-792;


CYCLOSILICATE
PHYLLOSILICATE
INOSILICATE
REFLECTANCE
WAVELENGTH
0.0
0.1
0.2
0.4
0.6
0.8
1.0